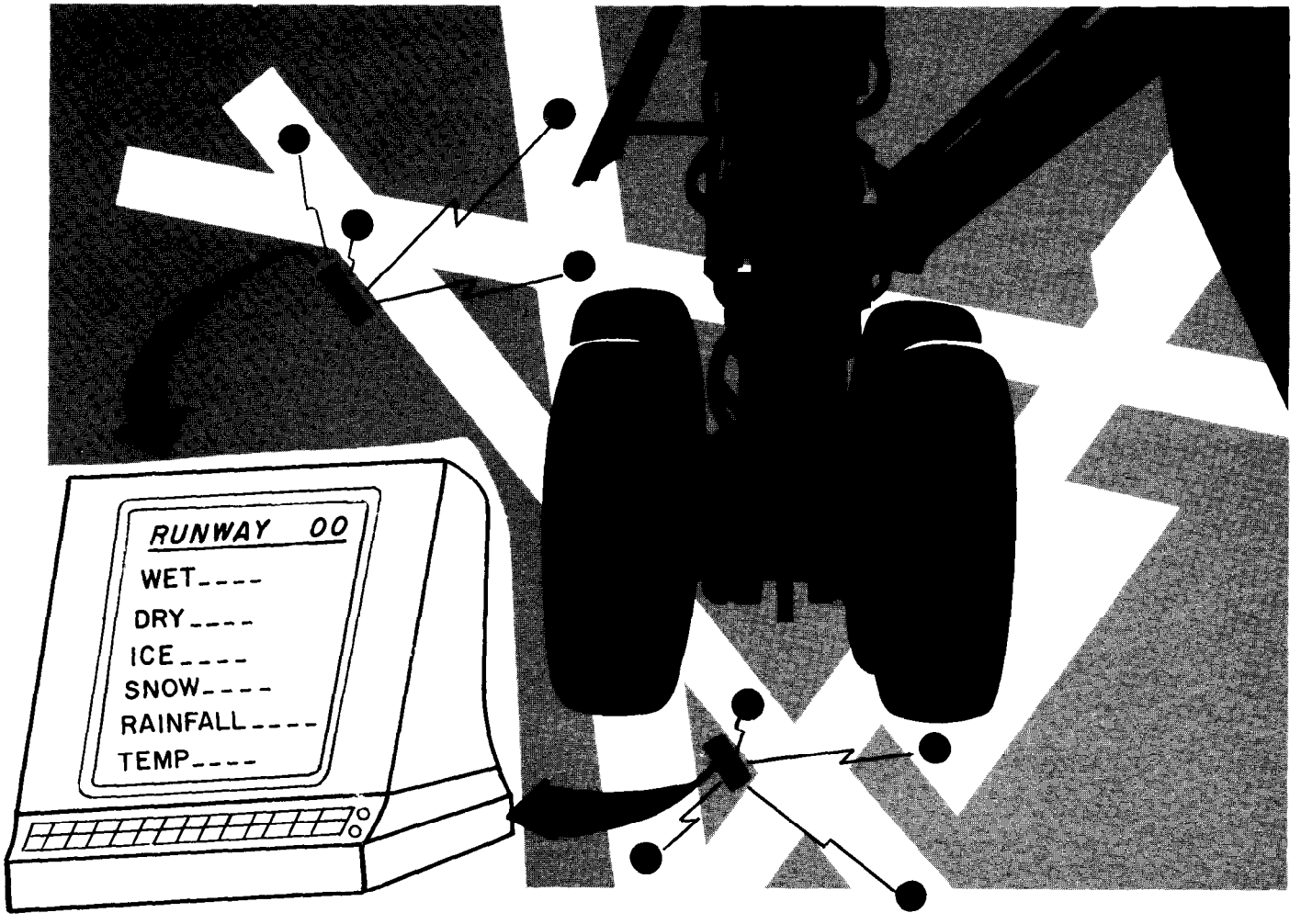
U.S. Department
of Transportation
Federal Aviation
Administration

Runway Surface Condition Sensor Specification Guide

AC: 150/5220-13B
Date: 3/27/91

Advisory Circular



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**Federal Aviation
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Advisory Circular

Subject:

Date: 3/27/91
Initiated by: AAS-120

AC No: 150/5220-13B
Change:

1. **PURPOSE.** circular assist consultants, and design engineers in the preparation specifications for sensor systems which monitor and report

2. **CANCELLATION.** AC 150/5220-13A, Runway Surface Condition Sensor Specification Guide, dated 4/22/83, is cancelled.

3. **APPLICATION.** The standards and specifications contained in this advisory circular are recommended by Aviation Administration (FAA) for and runway surface condition sensor systems at civil Federal grant- compliance with this AC is mandatory.

4. **SAFETY INFORMATION DISSEMINATION.** Airport operators are responsible for assessing and in the vicinity of the airport which may affect aircraft safety.

capability of automatically providing, on remote of the runway surface at multiple locations. This assist in more effective

pavements at the same an operator's ability to disseminate information about conditions on the areas. Although monitoring systems relieve responsibility for reporting pavement surface conditions, they can assist in fulfilling that responsibility.

5. **PRINCIPAL REVISION.** This AC has been revised siting criteria for the remote processing units in sensor systems and make changes.

Leonard E. Mudd
LEONARD E. MUDD
Director, Office

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CHAPTER 1. INTRODUCTION

1. **OVERVIEW.** Ice begins to form on pavements when the pavement surface reaches the freezing temperature of any solution on it. Runway surface condition sensor systems can detect the formation and/or existence of Sensor systems can also the ice to form. By the is conserved, and costs for ice control materials are reduced.

2. SENSOR SYSTEM CONCEPT. The use with at a point above the surface predict the occurrence of ice is primarily because surfaces and ambient air. Factors such as runway surface color and composition, wind velocity and direction, surface moisture, atmospheric moisture content, traffic angle also influence the ice. Runway surface condition sensor systems, therefore, have become a prevention program.

3. ICE-CONTROL TECHNIQUES. Prevention of is removal, in cost.

a. Anti-icing. is the most effective method of airport ice control, is achieved by applying chemicals to the pavements prior to the formation of include:

(1) Safety. Application of chemicals prior to ice formation prevents ice from reducing surface

(2) Cost. Since no chemical is required dissolve between the ice and less chemicals are required. Anti-icing requires between 30 to 75 percent less chemicals

(3) **Runway/Taxiway Downtime.** Ice prevention requires less airport operational area downtime because the chemicals are the moment of application and no waiting period is required while melts.

b. Deicing. Chemicals are formation of ice. Larger amounts of chemicals are needed to lower the water's freezing point and to dissolve the pavement. When the chemicals are used on ice, the water/chemical mixture ice, creating a more

c. Spot Application. Chemicals are applied only is observed or formation is often caused by the and surface states that exist on In general, the patchy areas the icy spots missed or excessive beyond the icy area. Remote runway sensors area historically know for patchy ice will permit effective ice.

CHAPTER 2. EQUIPMENT SPECIFICATION REQUIREMENTS

4. **GENERAL REQUIREMENTS.** Measurable events or changes on a pavement surface occur sequentially. Each as ice) has a end. A runway sensor system this section will and

5. **COMPONENTS.** The pavement surface

elements: in-pavement sensors; supporting power supply/signal processor units; processing units; display units/printers 2-1).

6. **MATERIALS.** Materials shall specifications described specifically listed, materials shall the purpose in commercial practice. Material and components shall be free from any defects or the system's function.

7. **DESIGN AND CONSTRUCTION.** The design of accordance with the most current engineering entire be designed complexity. design shall permit use, maintenance, and servicing. All components and assemblies shall for hazards which might cause injury to personnel or equipment. solid-state electronic devices equipment such as The system constructed so that no will be exposed System components withstand the climatic conditions at airports, i.e., rain, snow, temperature winds. built to and vibrations of taxiing, traffic.

8. **PERFORMANCE SPECIFICATIONS.**

a. The continuously real

nondestructive to pavement, nondegrading to the environment, to personnel. When activated, the data, with a time lag 3 a remote display console unit. The data or information transmitted shall be a easily understandable display following the

(1) Runway surface temperature, i.e., actual at the sampling site, in degrees C° (Celsius) or F° (Fahrenheit) with accuracy ½° degree F°;

(2) absence of moisture, e.g., dry pavement--no perceptible moisture, or wet surface;

(3) Pre-ice conditions--advance alert of incipient ice on the time to react depending on the air/pavement temperature drop rate and needs;

(4) Actual ice--visible or otherwise detectable ice on

(5) Ambient air temperature--at ground the vicinity runway.

b. The in-pavement sensor head shall be capable the above a stable mode, display unit by buried cable or a radio Equipment shall be able using conventional power sources available on the airport protected system shall function with minimal servicing or adjustment.

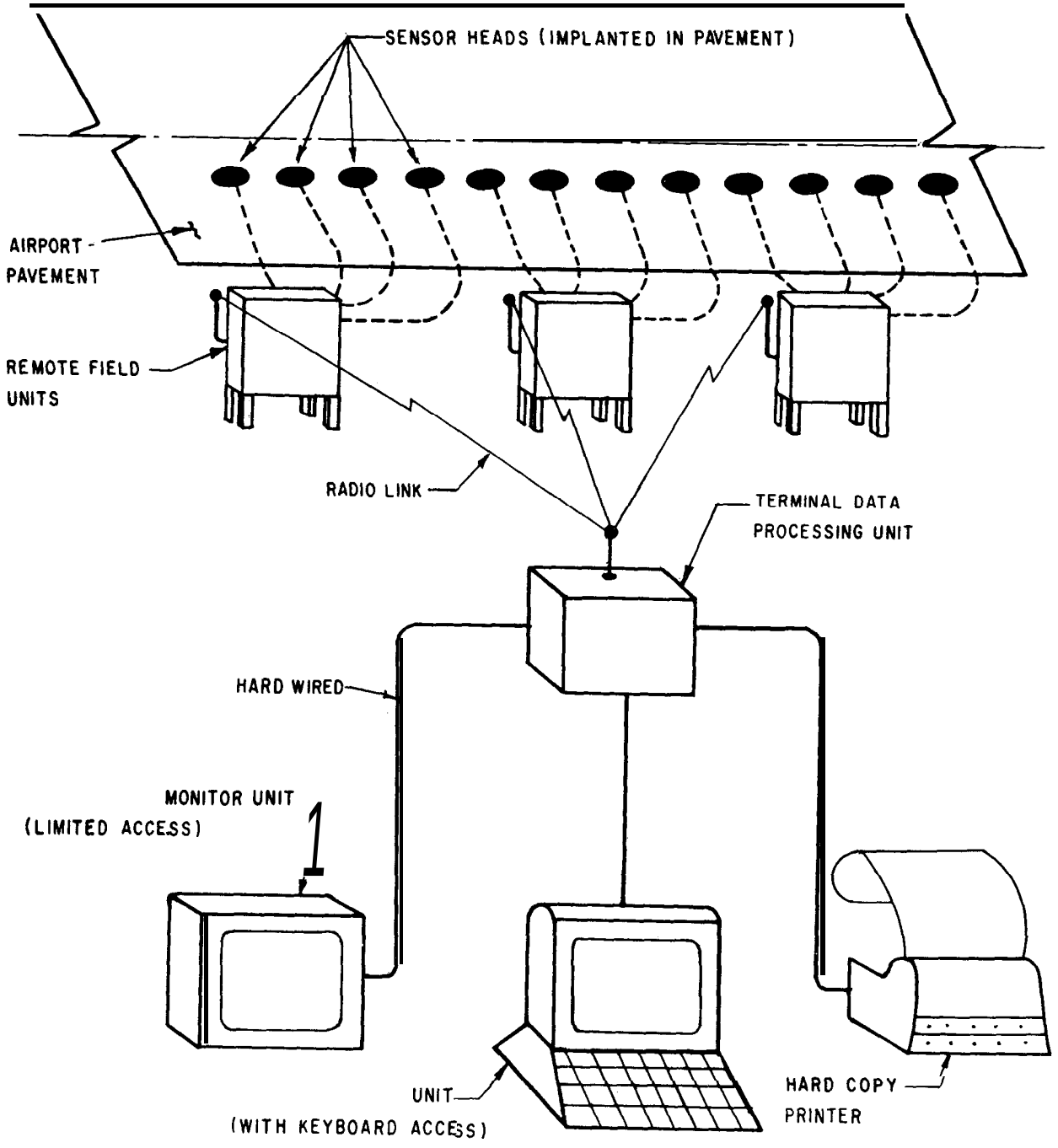
9. **PRIMARY SYSTEM COMPONENTS.** system follow:

a. **Pavement Condition Input Device. The** most system, because difficulty of servicing or replacing it, is the in-pavement sensor or pavement condition input device. This sensor senses transmits information to system for processing. The sensor component (head) is the the plane surface. or head shall conform to the

(1) Internal components shall be solid

devices. The head shall be factory adjusted and in the field.

SYSTEM COMPONENT DESIGN



System component design

(2) All electronic components shall be moisture, and vibration. The to the a leak-proof design. An additional waterproof seal may be installed on the cable/head cable/cable against moisture wicking.

(3) shall be a of a noncorrosive material, with a thermal conductivity closely approximating the surrounding airport pavement shall on a site-specific basis to each pavement surface to simulate actual pavement heat emission and absorption of solar radiation.

(4) surface texture shall surface and approximate the flow and pooling characteristics pavement.

(5) The component head design and configuration shall require a pavement installation complexity than for a standard in-pavement i.e., core and/or cable-way saw cut for head.

(6) The power/data transmission cable shall sufficient length to a site a minimum of 2,000 feet (608 the head.

(7) The head shall have sufficient durability to function over a surface or air temperatures from +175° F (+80° C) to -20° F (-29° C).

b. **Power Supply/Signal Processor Units.**

(1) Remote Field Unit. This component provides power to the in-pavement sensor head, processes air temperature and related atmospheric data, and transmits the processed data to the terminal data processing unit. The units shall be capable of supplying power to, and processing data from, a sensor heads.

(a) **Alignment.** and shall from these units and shall change shall be designed to difficulty.

(b) **Location.** shall in accordance with in paragraph 14; and, extent existing navigation facilities. They shall be mounted aboveground on frangible couplings.

(c) **Enclosure.** Remote shall the National Electrical Manufacturer's Association (NEMA) standards for type 4 or equivalent. The enclosure shall be designed so that service can be performed with minimum exposure to the critical system.

(d) **Data Transmission.** The recommended means of transmitting data to the terminal unit is by radio telemetry using standard in the frequency range of 170-176 transmission method may be by use cables. When radio telemetry is frequency and installation management office.

(2) Terminal Data Processing Unit. This unit receives by radio telemetry, phone lines, remote the system. It stores the transmits the display units. This unit the ability to process data from up to 120 in-pavement sensor heads. This unit shall solid-state electronic construction and have appropriate micro-processor the system requirements. The be operation sheltered environment operation at temperatures from 30°F (-1°C) to 120°F (49°C). shall have provision for additional plug-in devices to expand memory and output capabilities. may offer dialing.

c. **Data Display Unit.** This unit real input information from the terminal data processing unit and data manually inserted by keyboard display unit by other means. on a cathode ray tube (CRT) and/or a hard The information displayed shall data dictated by operational needs airport. The display shall information in a understood display unit shall be a conventional off-the-shelf design

requiring no special hardware to operate or install. The display unit electronics shall be primarily solid state. Optional software/hardware
improve the are:

(1) **Graphics.** Graphs showing the sequence.

(2) **Information highlight.**
a critical by a
display.

(3) **Additional Information.** Additional

displayed separate from sensor data using a display format user's needs.

(4) **Additional Monitor Units.** Duplicate displays at remote sites surface information is needed. The duplicate displays are created by
to the master data display unit. These additional monitors keyboards system is capable of displaying manually inserted data to

(5) **Remote Signalling.** The ability to page

(6) **Chemical Detection.** The ability to detect chemicals on the runway surface and to approximate of chemicals

(7) **Atmospheric Condition Detection.** The ability
wind speed, dew
humidity.

10. **REQUIRED PROTECTION AND SYSTEM STANDARDIZATION.**

a. **Circuit Protection Devices,** The
be powersurge protected, using devices.

b. **Power Supply System.** The
standard relays, circuit devices,
of

11. **ANCILLARY EQUIPMENT.** Ancillary equipment necessary system may FCC-approved, single-frequency radio telemetry system conforming limits for nonaeronautical use on guideline).

12. **ELECTRICAL POWER REQUIREMENTS.**

requirements and should have the
power ranges:

a. Sensor head - .5 watts.

b.
- 200 watts, + 50 watts.

c. - 700 watts, + 100 watts.

d. for complete system standard 110-130 VAC at 50/60 220-260 VAC at 50/60 HZ.

13. **MANUFACTURERS CERTIFICATION.** The manufacturer
the results of compliance applicable specifications. In addition, the manufacturer a written warranty which will correct by repair or replacement any defect in design, material, or workmanship use in the first provided the installation was in accordance with the FAA and manufacturers' specifications. shall also agree to maintain a testing/evaluation/quality control program for all the system components. Particular be placed on quality control and climatic/reliability testing of the in-pavement sensor heads.

CHAPTER 3. SENSORS UNITS

14. **LOCATION OF REMOTE PROCESSING UNITS.** The a remote processing unit is to a degree fixed by function. Where practical, these units with air navigational aids (OFA); runway safety area (RSA) obstacle-free zone is not possible, the be sited runway and taxiway, RSA, last 1,000 feet (304 m) runway. The conform to the object clearing criteria contained in AC 150/5300-13, Airport function).

15. **LOCATION OF INPUT DEVICES--IN-** can transitioning parking In-pavement sensors shall be located

a. **Touchdown Zone.** To monitor conditions affecting control and stability and then aircraft braking ability.

b. **Mid-runway.** To monitor conditions affecting and the capability taxiways.

c. **Runway Exits.** To monitor conditions the capability to turn.

d. **Taxiways and Aprons.** To monitor conditions affecting low speed maneuvering and parking.

16. **NUMBER OF SENSORS.** There a devices or in-pavement sensors per runway. Factors which may require additional sensors for the taxiways, areas 3-1) are:

a. **Color and Crown.** Differences color affect the absorption rates snow. (concrete) before darker candidates sensors. Areas slower the possibility of These sites are also candidates for additional sensors.

b. **Temperature Differences on Pavement.** As conditions, some pavement areas will have colder surface pavements and form ice earlier or more persistently. Temperature variations will result not only from differences in subgrade materials but in the angle rays as a other phenomena.

17. **SENSOR PLACEMENT AS FUNCTION OF COMPLEX AIRPORT CONFIGURATION.** As the operations increases, not only of monitoring surface conditions by manual inspection increase, devices or sensors must be increased. As a for sensors will range from a 3 for a 3,000-foot (900 to 12 or more sensors in a 10,000-foot (3 000 m) and Local control can provide insight into unusual needs and the sensors.

18. **GEOGRAPHIC LOCATION.** is for airport ice prevention, with the aid of pavement condition detection systems, is significant in these zones.

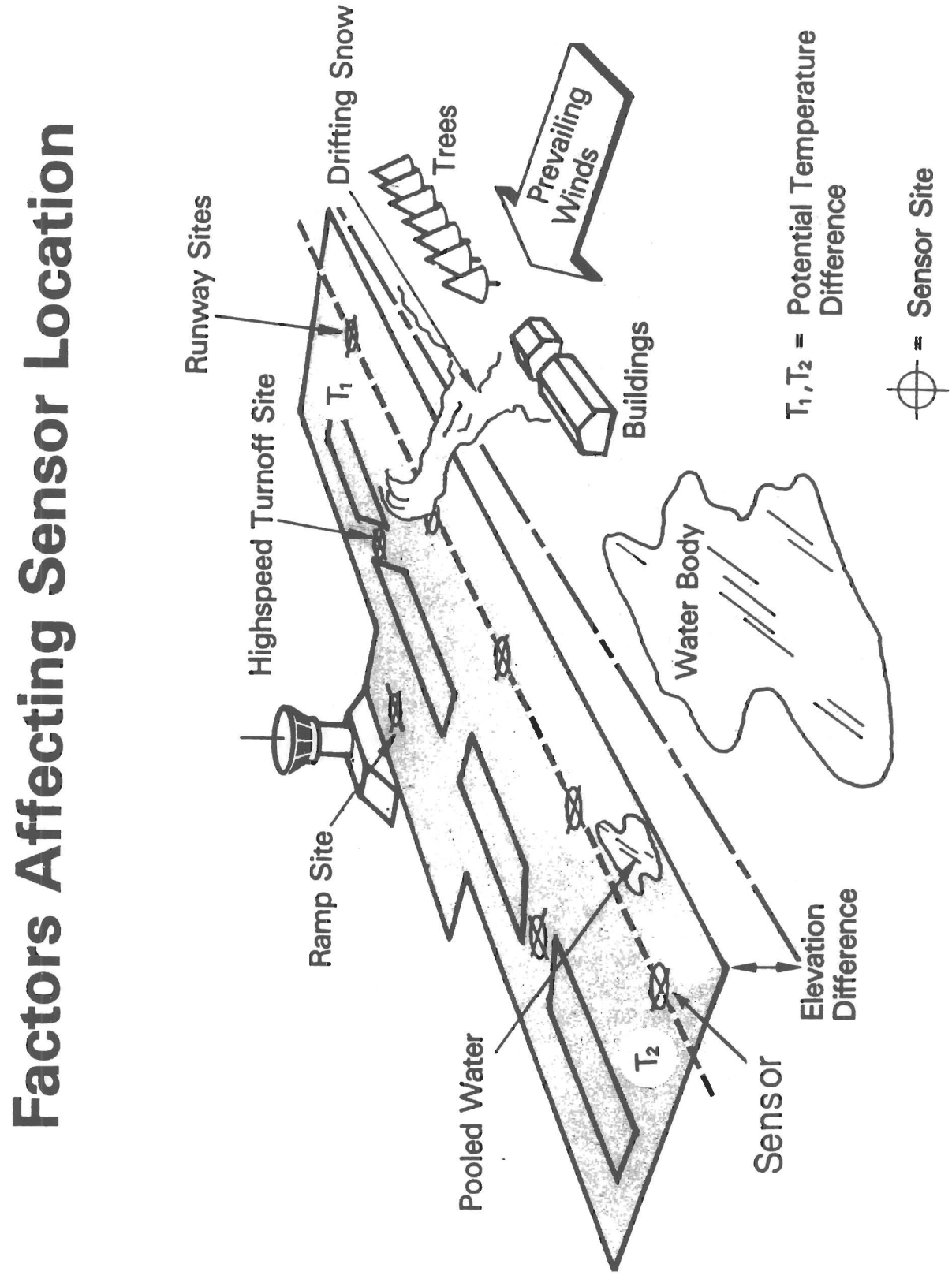


Figure 3-1. Factors affecting sensor location

CHAPTER 4. INSTALLATION CRITERIA

19. **GENERAL.** The procedure for installing the input device is the pavement in the manufacturers' installation specifications.

20. Holes are sawed the cables are sawed from for the sensor edge. The sides cable kerf shall be necessary) and a air jet or wiped dry to ensure a good sealing agent.

21. **INSTALLATION SENSOR HEAD.** sensor head with traffic is essential for proper self- the conductive probes sensor. Sensor be flush surface and in the pavement surface. When filling the shall fills the cavity and does not extrude over the sensor head. The in the or similar devices is the manufacturers' agent.

AC Centerline Lighting System, 150/5340-4C, Installation Centerline and Touchdown Zone Lighting Systems, provide recommendations.

22. **CONNECTION/INSPECTION AND TEST.** Connections from in-pavement sensor heads to the remote field from the to the airport power supply shall be made in manufacturers' instructions FAA advisory circulars referenced 21. The connections and the complete system aligned during installation. Since any in- problems sensor units are sealed in the runway, a complete check for all sensor functions shall be accomplished prior to sealing and/or project completion. All test equipment and adjustments a particular by the system manufacturer. All elements of the sensor electric power supply system, including materials, to national, practices or codes for systems electrical power requirement covers cable, cable burial, electrical tie-ins, and other equipment operation.

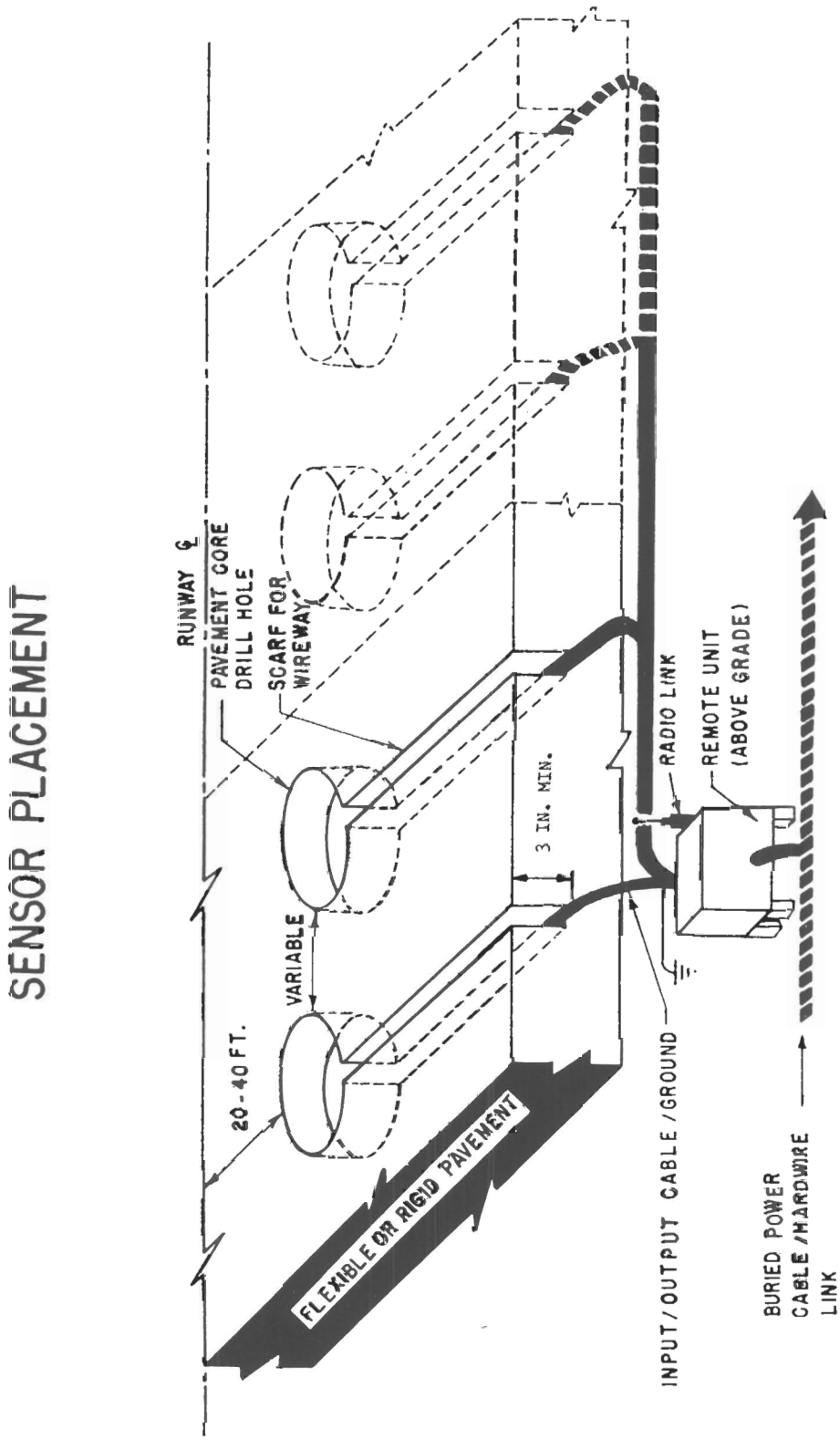


Figure 4-1. Sensor placement